2003-09

Effects of high baroclinic equatorial Kelvin waves on ENSO onset

Sun, J.L.

Chu, P.C., J.L. Sun, and Q.Y. Liu, Effects of high baroclinic equatorial Kelvin waves on ENSO onset. International Conference on Earth System Modeling, Hamburg, Germany, 15-19

International Conference on Earth System Modeling
Variability of the Coupled Earth system at Different Time Scales
Seasonal to Interannual Time Scales
Max Planck Institute for Meteorology, 5-19 September 2003

Effect of high baroclinic equatorial Kelvin waves on ENSO onset

Chu, P., Naval Postgraduate School, Monterey, Californis, USA (chu@nps.navy.mil, tel: 1-831-656-3688)
Sun J., and Q. Liu, Ocean University of China, Qingdao, China

On the base of nonlinear equatorial wave dynamics, a two-stage westerly wind burst mechanism is proposed to explain the central equatorial Pacific warming and its effect on the onset of El Nino and Southern Oscillation (ENSO) event. The first-stage westerly wind bursts occur in boreal winter over the western equatorial Pacific and generate the 'first-stage' Kelvin waves, propagating in stratified ocean with vertically sheared mean currents U (e.g., zonal jet such as the equatorial undercurrent). Wave-current interaction significantly modifies the structures and dispersion characteristics of the baroclinic Kelvin waves, depending on the speed and the spatial scales of the jet relative to those of waves. The first baroclinic mode has the phase speed (c) much larger than U (ranging between 0-1.5 m/s), and it is modified least structurally by the Doppler shift, and causes eastward propagation of weak warm SST anomaly. Conversely, the high (especially the second) baroclinic modes have the phase speed comparable to the mean speed, and they are modified structurally or even ceased propagation by the Doppler shift. When the second baroclinic mode ceases its propagation in the central Pacific, positive SST anomaly appears that shifts the atmospheric convection zone from the western to central equatorial Pacific and in turn causes the second-stage westerly wind bursts over a broad area covering the western and central Pacific. The second-stage westerly wind bursts generate the 'second-stage' Kelvin waves with the first baroclinic mode carrying sufficient warm SST anomaly and causing the ENSO onset. This theory was verified using TOGA-TAO data and numerical model simulation.